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NAVFAC **IGS-15730 (MAY 2003)**

Preparing Activity: LANTNAVFACENGCOM **Based on UFGS-15730N**

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

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SECTION 15730

UNITARY AIR CONDITIONING EQUIPMENT
05/03

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NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

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NOTE: This guide specification covers room air conditioners, ductless split units, heat pumps, and air conditioners of the single package or split system type.

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 (1994; Errata 1994) Safety Code for Mechanical Refrigeration

ASME INTERNATIONAL (ASME)

ASME/ANSI B31.5 (1992; Errata 1993) Refrigeration Piping

ITALIAN LAWS AND NORMS (D.M.)(LAW)(CIRC.)

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NOTE: Italian laws and normatives are the legislative regulations and decrees issued by the Italian government in the form of laws, norms, decrees, circulars, and letters. These Laws and Decrees concur together with Norms and Standards in forming the governing directives for construction.

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Law 46 (05/03/1990) Safety Norms for Systems.

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

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NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

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UNI 5311 (1963) Gripping and holding appliances - Straps, clamps, squares and bearings - Summary of standard types

UNI 7145 (1972) Pipe clamps for use on board ships - Summary of standard types

UNI 7773-1 (1981) Seamless copper tubes for general purpose - Qualities, requirements and tests

UNI 10376 (1994) Thermal insulation for heating and cooling systems for buildings

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN) (UNI EN ISO)(UNI ISO)

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NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

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UNI EN 779	(1995) Particulate air filters for general ventilation - Requirements, testing, marking
UNI EN 814-1	(1999) Air conditioners and heat pumps with electrically driven compressors - Cooling mode - Part 1: Terms, definitions and designations
UNI EN ISO 846	(1999) Plastics - Evaluation of the action of microorganisms
UNI EN 1057	(1997) Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications
UNI EN 1254-1	(2000) Copper and copper alloys - Plumbing fittings - Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes
UNI EN ISO 1461	(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
UNI EN 1822-5	(2002) High efficiency particulate air filters (HEPA and ULPA) - Part 5: Determining the efficiency of filter element
UNI EN 10147	(2000) Continuously hot-dip zinc coated structural steel strip and sheet_- Technical delivery conditions
UNI EN ISO 10289	(2001) Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates - Rating of test specimens and manufactured articles subjected to corrosion tests
UNI EN 29453	(1996) Soft solder alloys - Chemical composition and forms

UNDERWRITERS LABORATORIES (UL)

UL 109	(1997) Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use
UL 900	(1994; R 1996) Air Filter Units

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

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NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significant to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

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Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Field-assembled refrigerant piping; G

Control system wiring diagrams; G

SD-03 Product Data

Room air conditioners; G

Split system heat pump; G

Packaged heat pump; G

Split system air conditioning unit; G

Packaged air conditioning unit; G

Packaged air handling unit; G

Filters; G

Refrigerant piping and accessories; G

Coatings for finned tube coils; G

For ductless split units, include indoor noise rating.

SD-06 Test Reports

[Room air conditioners - field acceptance test plan; G]

[Split system heat pump - field acceptance test plan; G]

[Packaged heat pump - field acceptance test plan; G]

[Split-system air conditioning unit - field acceptance test plan; G]

[Packaged air conditioning unit - field acceptance test plan; G]

[Packaged air handling unit - field acceptance test plan; G]

[Room air conditioners - field acceptance test report; G]

[Split system heat pump - field acceptance test report; G]

[Packaged heat pump - field acceptance test report; G]

[Split-system air conditioning unit - field acceptance test report; G]

[Packaged air conditioning unit - field acceptance test report; G]

[Packaged air handling unit - field acceptance test report; G]

Salt-spray tests

Start-up and initial operational tests

SD-08 Manufacturer's Instructions

Room air conditioners

Split system heat pump

Packaged heat pump

Split system air conditioning unit

Packaged air conditioning unit

Packaged air handling unit

Filters

Refrigerant piping and accessories

SD-10 Operation and Maintenance Data

Room air conditioners, Data Package 3; G

Split system heat pump, Data Package 3; G

Packaged heat pump, Data Package 3; G

Split system air conditioning unit, Data Package 3; G

Packaged air conditioning unit, Data Package 3; G

Packaged air handling unit, Data Package 3; G

Filters, Data Package 2; G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Posted operating instructions; G

1.4 QUALITY ASSURANCE

1.4.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Detail Drawing

For refrigerant piping, submit piping layout drawings, including pipe sizes, supports, and support details. Submit control system wiring diagrams. Wiring diagrams shall clearly define both factory wiring and field wiring.

1.4.3 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ASHRAE 15 and Law 46, including latest updated revisions.

1.4.4 Posted Operating Instructions

Submit posted operating instructions for each packaged air conditioning unit.

1.5 REFRIGERANTS

Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.00. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme.

PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Room Air Conditioners

The following manufacturers provide room air conditioner units that

generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

YORK ITALIA - YORK INTERNATIONAL S.p.A.
Via xxv Aprile, 29
20030 Barlassina (MI)
Tel: 362-5381
Fax: 362-565493
www.york.com

PANASONIC ITALIA S.p.A.
Via Lucini, 19
20125 Milano, Italy
Tel.: 39 02 67881
Fax: 39 02 6788427
www.panasonic.it

2.1.2 Ductless Split Units

The following manufacturers provide ductless split air conditioner units that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

YORK ITALIA - YORK INTERNATIONAL S.p.A.
Via xxv Aprile, 29
20030 Barlassina (MI)
Tel: 362-5381
Fax: 362-565493
www.york.com

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

DAIKIN AIR CONDITIONING ITALY S.p.A.
Via Trebbia, 20
20135 Milano, Italy
Tel.: 39 02 584551
Fax: 39 02 583173

www.daikin.it

PANASONIC ITALIA S.p.A.
Via Lucini, 19
20125 Milano, Italy
Tel.: 39 02 67881
Fax: 39 02 6788427
www.panasonic.it

2.1.3 Split System Heat Pumps, 18 kW and Smaller

The following manufacturers provide split system heat pumps, less than 18 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

DAIKIN AIR CONDITIONING ITALY S.p.A.
Via Trebbia, 20
20135 Milano, Italy
Tel.: 39 02 584551
Fax: 39 02 583173
www.daikin.it

PANASONIC ITALIA S.p.A.
Via Lucini, 19
20125 Milano, Italy
Tel.: 39 02 67881
Fax: 39 02 6788427
www.panasonic.it

2.1.4 Packaged Heat Pumps, 18 kW and Smaller

The following manufacturers provide packaged heat pump systems, less than 18 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

CLIVET ITALIA S.r.l.
Zona Industriale
32030 Villapaiera - Feltre (Belluno), Italy
Tel.: 39 0439 89844
Fax: 39 0439 81404
email: info@climaveneta.it

CLIMAVENETA S.p.A.
Via Sarson, 57/c
36051 Bassano del Grappa (Vicenza), Italy
Tel.: 39 0424 501448
Fax: 39 0424 509509
email: info@climaveneta.it

2.1.5 Split System Heat Pumps, 21 kW to 88 kW Capacity

The following manufacturers provide split system heat pumps, 21 kW to 88 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

CLIVET ITALIA S.r.l.
Zona Industriale
32030 Villapaiera - Feltre (Belluno), Italy
Tel.: 39 0439 89844
Fax: 39 0439 81404
email: info@climaveneta.it

CLIMAVENETA S.p.A.
Via Sarson, 57/c
36051 Bassano del Grappa (Vicenza), Italy
Tel.: 39 0424 501448
Fax: 39 0424 509509
email: info@climaveneta.it

2.1.6 Packaged Heat Pumps, 21 kW to 88 kW Capacity

The following manufacturers provide packaged heat pump systems, 21 kW to 88 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

CLIVET ITALIA S.r.l.
Zona Industriale
32030 Villapaiera - Feltre (Belluno), Italy
Tel.: 39 0439 89844
Fax: 39 0439 81404
email: info@climaveneta.it

CLIMAVENETA S.p.A.
Via Sarson, 57/c
36051 Bassano del Grappa (Vicenza), Italy
Tel.: 39 0424 501448
Fax: 39 0424 509509
email: info@climaveneta.it

2.1.7 Split System Air Conditioning Unit 18 kW and Smaller

The following manufacturers provide split system air conditioning units, less than 18 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

AERMEC S.p.A.
Via Roma, 44

37040 Bevilacqua (VR)
Tel: 0442-633111
Fax: 0442-93577
www.aermec.com

DAIKIN AIR CONDITIONING ITALY S.p.A.
Via Trebbia, 20
20135 Milano, Italy
Tel.: 39 02 584551
Fax: 39 02 583173
www.daikin.it

PANASONIC ITALIA S.p.A.
Via Lucini, 19
20125 Milano, Italy
Tel.: 39 02 67881
Fax: 39 02 6788427
www.panasonic.it

2.1.8 Packaged Air Conditioning Units 18 kW and Smaller

The following manufacturers provide packaged air conditioning units, less than 18 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

CLIVET ITALIA S.r.l.
Zona Industriale
32030 Villapaiera - Feltre (Belluno), Italy
Tel.: 39 0439 89844
Fax: 39 0439 81404
email: info@climaveneta.it

CLIMAVENETA S.p.A.
Via Sarson, 57/c
36051 Bassano del Grappa (Vicenza), Italy
Tel.: 39 0424 501448
Fax: 39 0424 509509
email: info@climaveneta.it

2.1.9 Split System Air Conditioning Unit 21 kW to 88 kW Capacity

The following manufacturers provide split system air conditioning units, 21 kW to 88 kW size, that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

AERMEC S.p.A.
Via Roma, 44
37040 Bevilacqua (VR)
Tel: 0442-633111
Fax: 0442-93577
www.aermec.com

CLIVET ITALIA S.r.l.
Zona Industriale
32030 Villapaiera - Feltre (Belluno), Italy
Tel.: 39 0439 89844
Fax: 39 0439 81404
email: info@climaveneta.it

CLIMAVENETA S.p.A.
Via Sarson, 57/c
36051 Bassano del Grappa (Vicenza), Italy
Tel.: 39 0424 501448
Fax: 39 0424 509509
email: info@climaveneta.it

AIR BLUE S.r.l.-BLUE BOX S.r.l.
Via E. Mattei, 6
35028 Piove di Sacco (PD), Italy
Tel.: 39 049 9716300
Fax: 39 049 9704105
www.bluebox.it

2.1.10 Packaged Air Conditioning Units 21 kW and Larger

The following manufacturers provide packaged air conditioning units of 21 kW size and larger that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361

Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

CLIVET ITALIA S.r.l.
Zona Industriale
32030 Villapaiera - Feltre (Belluno), Italy
Tel.: 39 0439 89844
Fax: 39 0439 81404
email: info@climaveneta.it

CLIMAVENETA S.p.A.
Via Sarson, 57/c
36051 Bassano del Grappa (Vicenza), Italy
Tel.: 39 0424 501448
Fax: 39 0424 509509
email: info@climaveneta.it

2.1.11 Packaged Air Handling Unit

The following manufacturers provide straight cool packaged air handling units that generally comply with these specifications:

CARRIER S.p.A.
Via Raffaello Sanzio, 9
20058 Villasanta (MI)
Tel: 039-36361
Fax: 039-3636510
www.carrier.it

TRANE ITALIA Srl
Via Enrico Fermi 21/33
20090 Cusago (MI)
Tel: 02-457951
Fax: 02-4880170
www.trane.com

2.1.12 Filters

The following manufacturers provide replaceable, high efficiency, and cleanable type filters that generally comply with these specifications:

TECHNIK S.p.A.
via dei Lavoratori, 78
20092 Cinisello Balsamo (MI)
Tel: 02-660761
Fax: 02-660-76329
www.technik.it

FCR S.p.A.
Via Enrico Fermi, 3
20092 Cinisello Balsamo (MI)
Tel: 02-617981
Fax: 02-61798300
www.fcr.it

GENERAL FILTER
Via Caracciolo, 13
20010 Barbaina di Lainate (MI)
Tel: 02-93550640
Fax: 02-93255670
www.generalfilter.com

VEFIM SISTEMI DI FILTRAZIONE S.r.l.
Strada dell'Alpo, 3
37136 Verona
Tel: 045-581913
Fax: 045-8202126
www.vefim.it

CAMFIL S.p.A.
Via Cajkovskij 24/22
20092 Cinisiello Balsamo (MI),Italy
Tel.: 39 02 66048961
Fax: 39 02 66048120

TROX ITALIANA S.p.A.
Via Piemonte 23/D/C
20098 San Giuliano Milanese (MI), Italy
Tel.: 39 02 9829741
Fax: 39 02 98297460

2.2 ROOM AIR CONDITIONERS

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NOTE: Equipment having a higher efficiency than required by ASHRAE 90.1 shall be specified if shown to be life-cycle cost effective. Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

UNI EN 814-1. Minimum energy efficiency ratio (EER) shall be as scheduled. Provide units removable from inside the building for servicing without removing the outside cabinet. Construct outside cabinets, including metal grilles to protect condenser coils, of zinc-coated steel or aluminum. Steel and zinc-coated surfaces shall receive at least one coat of primer and manufacturer's standard factory applied finish Insulate cabinets to prevent condensation and run off of moisture. Provide mounting hardware made of corrosion resistant material or protected by a corrosion resistant finish. Provide air filters of the [throw-away] [or] [permanent washable]

type removable without the use of tools and arranged to filter both room and ventilating air. Remove condensate by means of a drain or by evaporation and diffusion. Provide with metal or plastic mounting flanges on each side, top, and bottom of unit. For thru-the-wall installations provide aluminum or shop painted zinc-coated steel flanged telescopic wall sleeves. Design wall sleeves to restrict driving rain. For window mounted units provide shop painted metal mounting brackets, braces, and sill plates. Mount compressors on vibration isolators. Minimum cooling capacity shall be not less than that indicated. [Provide light tight units serving dark rooms.]

2.2.1 Units for Operation on 220 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15- or 20-amp, 3-pole, 220 volt ground type plug to match receptacle.

2.2.2 Units for Operation on 208 or 230 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15-, 20-, or 30-amp, 3-pole, 250 volt ground type plug to match receptacle.

2.2.3 Controls

Mount controls in cabinet. Manual controls shall permit operation of either the fan or the fan and refrigerating equipment. Fan control shall provide two fan speed settings. Automatic controls shall include a thermostat for controlling air temperature. Thermostat shall have an adjustable range, including 22 to 27 degrees Cand shall automatically turn the refrigeration system on or off to maintain the preselected temperature within plus or minus 20 degrees C.

2.3 SPLIT SYSTEM HEAT PUMP, 18 kW AND SMALLER

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NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

2.3.1 Concealed Evaporator-Fan Components

2.3.1.1 Chassis

Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

a. Insulation: Faced, glass-fiber duct liner.

b. Drain Pans: Corrosion protected steel or PVC, with connection for drain; insulated.

c. Suitable for vertical or horizontal mounting.

2.3.1.2 Refrigerant Coils

Copper tube, with mechanically bonded aluminum fins and with thermal expansion valve or orifice. Coils shall be factory pressure and leak tested.

2.3.1.3 Electric Coil

Helical, nickel-chrome, resistance wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual reset thermal cutout; airflow proving device; and one time fuses in terminal box for overcurrent protection.

2.3.1.4 Fan

Forward curved, double width wheel of galvanized steel; directly connected to motor.

2.3.1.5 Fan Motor

Multi-speed, PSC type.

2.3.1.6 Disposable Filters

25 mm thick, in fiberboard frames.

2.3.1.7 Wiring Terminations

Connect motor to chassis wiring with plug connection.

2.3.2 Ductless Evaporator-Fan Components

Provide [wall mounted] [ceiling mounted] [or] [cassette type] ductless evaporator-fan components.

2.3.2.1 Cabinet

Enameled steel with removable panels on front and ends, and discharge drain pans with drain connection.

2.3.2.2 Refrigerant Coils

Copper tube, with mechanically bonded aluminum fins and with thermal expansion valve.

2.3.2.3 Electric Coil

Helical, nickel-chrome, resistance wire heating elements with refractory ceramic support bushings; automatic reset thermal cutout; built-in magnetic contactors; manual reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

2.3.2.4 Fan and Motor

Centrifugal fan, directly driven by multispeed, electric motor with integral overload protection; resiliently mounted.

2.3.2.5 Filters

Permanent and cleanable.

2.3.3 Air-Cooled, Compressor-Condenser Components

2.3.3.1 Casing

Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2.3.3.2 Compressor

Hermetically sealed and mounted on vibration isolation. Furnish with oil system, operating charge, and motor. Compressor motor shall have thermal and current sensitive overload devices, start capacitor, relay, and contactor. Motor shall be suitable for operation in a refrigerant atmosphere.

a. Compressor Type: Reciprocating or scroll.

b. Compressor motor with manual reset high pressure switch and automatic reset low pressure switch.

[c. Crankcase Heater: Provide unit with compressor oil sump heater.]

2.3.3.3 Refrigerant Coils

Copper tube, with mechanically bonded aluminum fins and with liquid subcooler. Tubes shall be cleaned, dehydrated, and sealed. Coils shall be factory pressure and leak tested. [Provide phenolic epoxy corrosion-protection coating to condenser [and evaporator] coils.]

2.3.3.4 Refrigeration Components

Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulator (if required by manufacturer), bi-flow filter drier, pressure relief, reversing valve, heating mode metering device, and low temperature air cut-off thermostat.

2.3.3.5 Fan

Aluminum propeller type, directly connected to motor.

2.3.3.6 Motor

Permanently lubricated, with integral thermal overload protection.

2.3.3.7 Operating Characteristics

Unit shall be capable of starting and running at 46 degrees C ambient outdoor temperature. Compressor with standard controls shall be capable of operation down to 12.7 degrees C ambient outdoor temperature.

2.3.3.8 Controls and Safeties

Operating controls and safeties shall be factory selected, assembled, and tested. The minimum functions shall include the following:

a. Controls:

1) Time delay restart to prevent compressor reverse rotation on single phase scroll compressors.

2) Automatic restart on power failure.

3) Safety lockout if any outdoor unit safety is open.

4) A time delay control sequence is also provided standard through the fan coil board, thermostat, or controller.

5) High pressure and liquid line low pressure switches.

6) Automatic outdoor fan motor protection.

7) Start capacitor and relay (single phase units without scroll compressors).

b. Safeties:

1) System diagnostics.

2) Compressor motor current and temperature overload protection.

3) High pressure relief.

4) Outdoor fan failure protection.

c. Electrical Requirements:

1) Unit shall operate on single phase, 50 Hz power at 220 volts.

2) Unit electrical power shall be a single point connection.

3) Provide unit control voltage to the indoor fan coil.

4) Unit shall have high- and low-voltage terminal block connections.

****
NOTE: When the split system equipment is required to provide cooling at outside air temperatures below 12.7 degrees C, the low ambient kit should be specified for the equipment. The Liquid Solenoid Valve should be specified with all long-refrigerant lines applications (over 30 meters).
****

d. Special Features (Field Installed):

[1) Low-Ambient Kit: Control shall regulate fan motor cycles in response to saturated condensing pressure of the unit. The control shall be capable of maintaining a condensing temperature of 37.8 degrees C +/- 5.5 with outdoor temperatures to - 17.8 degrees C.]

[2) Liquid Solenoid Valve: This electronically operated shutoff valve shall close and open in response to compressor operation.]

2.3.4 Accessories

****
NOTE: Select one of the following 2 choices.
****

[2.3.4.1 Thermostat

Low voltage with subbase to control compressor and evaporator fan. Provide with temperature indication and adjustment, fan "on-auto", and "heat-off-cool" functions. provide emergency heat control and indication when provided. Thermostat shall include an automatic reset timer to prevent rapid cycling of compressor.

][2.3.4.2 Thermostat

****
NOTE: The wireless infared option is only available with some ductless evaporator-fan options. Coordinate for availability before using this option.
****

Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

a. Compressor time delay.

b. 24 hour time control of system stop and start.

c. Liquid crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

d. Fan speed selection, including auto setting.

]2.3.4.3 Refrigerant Line Kits

Soft annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory insulated suction line with flared fittings at both ends.

2.4 PACKAGED HEAT PUMP, 18 kW AND SMALLER

****

NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.

****

Factory assembled and tested, single piece, air-to-air heat pump; designed for exterior installation. Complete with compressor, indoor and outside refrigerant coils, indoor (evaporator) fan and outside (condenser) fan, refrigeration and temperature controls, filters, dampers, and factory wiring and piping.

2.4.1 Unit Cabinet

Steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts.

a. Insulate internal cabinet surfaces with minimum 13 mm thick thermal insulation coated on the air side so insulation material will not delaminate when exposed to the air stream.

b. Unit shall include sloped non-corrosive drain pan with minimum 20 mm external condensate piping connection.

c. Furnish with knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

2.4.2 Indoor (Evaporator) Fan

Forward curved, centrifugal, [belt driven] [or] [directly driven by multi-speed motor]. Steel fan wheel with corrosion resistant finish, double inlet type, and dynamically balanced.

2.4.3 Outside (Condenser) Fan

Propeller type, aluminum blades riveted to corrosion resistant steel body, direct drive motor, dynamically balanced.

2.4.4 Motors

Compressor motors shall be refrigerant cooled type with thermal and current overload protection. Furnish fan motors with permanently lubricated bearings and thermal overload protection. Outdoor (condenser) fan motor shall be totally enclosed type.

2.4.5 Refrigerant Coils

Aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Steel coil casing with equalizing type vertical distributor. Tubes shall be cleaned, dehydrated, and sealed. Factory pressure and leak test coils. [Provide phenolic epoxy corrosion-protection coating to condenser [and evaporator] coils.]

2.4.6 Compressors

Manufacturer's standard hermetic compressor with integral vibration isolators and internal pressure relief. Furnish with oil system, operating charge, and motor. Compressor motor shall have thermal and current sensitive overload devices, start capacitor, relay and contactor. Motor shall be suitable for operation in refrigerant atmosphere. [Provide with compressor oil sump heater.]

2.4.7 Refrigeration System

Shall include, but not be limited to, the following components:

a. Compressor.

b. Outside (condenser) coil and fan.

c. Indoor (evaporator) coil and fan.

d. 4-way reversing valve[and suction line accumulator if required by manufacturer].

e. Expansion valve.

f. Refrigerant dryer.

g. High pressure switch.

h. Low pressure switch.

i. Thermostat for coil freeze-up protection during low-ambient temperature operation or loss of air.

j. Low ambient switch.

k. Brass service valves installed in discharge and liquid lines.

l. Charge of refrigerant.

2.4.8 Filters

Provide filters of the type specified in this section.

2.4.9 Electric Heat

Helix wound, nickel-chrome, electric resistance elements, factory wired for

single point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices. Heater elements shall be adequately supported and insulated with ceramic bushings. Provide capacity and characteristics as indicated in equipment schedule.

****
NOTE: Select either the outdoor air damper or the economizer.
****

[2.4.10 Outside Air Damper

[a. Linked damper blades, for 0 to 25 percent outside air, bird screen, and hood.]

[b. Fully modulating, spring return damper motor, bird screen, and hood.]

][2.4.11 Economizer

Return and outside air dampers with neoprene seals, outside air filter, and hood.

a. Damper Motor: Fully modulating spring return with adjustable minimum position.

b. Control: Electronic control system uses [outside air temperature] [mixed air and outside air temperature] [outside air enthalpy] to adjust mixing dampers.

c. Relief Damper: Gravity actuated with bird screen and hood.

]2.4.12 Power Connection

Provide for single connection of power to unit with [unit-mounted disconnect switch accessible from outside unit and] control-circuit transformer with built-in circuit breaker.

2.4.13 Operating Characteristics

Unit shall be capable of starting and running at 46 deg. C ambient outdoor temperature. Compressor with standard controls shall be capable of operation down to 4.4 deg. C ambient outdoor temperature.

****
Note: Select control options from following 3 paragraphs. Control options shall be coordinated with existing base controls and project budget.
****

[2.4.14 DDC

Install stand alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature control

system specified in Section 15910, "Direct Digital Control System."

][2.4.15 Electromechanical Thermostat

Staged heating and cooling on subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

a. Night setback operation with single stage heating control with [7 day] [24 hour] time clock with battery backup.

b. Fan proving switch to lock out unit if fan fails.

c. Dirty filter switch.

][2.4.16 Thermostat

Programmable, electronic; with heating setback and cooling setup with 7 day programming; and the following:

a. Touch sensitive keyboard.

b. Automatic switching.

c. Deg C readout.

d. LED indicators.

e. Hour/day programming.

f. Manual override capability.

g. Time and operational mode readout.

h. Status indicator.

i. Battery backup.

j. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

k. Fan proving switch to lock out unit if fan fails.

l. Dirty filter switch.

][2.4.17 Optional Accessories

[a. Low Ambient Package: Solid state control and condenser coil temperature sensor for controlling outdoor (condenser) fan motor operation, that shall allow unit to operate down to minus 17 deg. C outdoor ambient temperature.]

[b. Service Outlets: One duplex outlet, 220V, ground fault, circuit interrupter type, protected from weather.]

[c. Dirty filter switch.]

[d. Coil guards of painted, galvanized steel wire.] [Hail guards of steel, painted to match casing.]

[e. [Step-down] [Flush] diffuser with aluminum grilles, insulated diffuser box with flanges, and interior transition.]

]2.4.18 Roof Curb

Steel with corrosion-protection coating, gasketing, and factory installed wood nailer; minimum height of [350] [600] [___] mm.

2.5 SPLIT SYSTEM HEAT PUMP, 21 kW to 88 kW CAPACITY

****
NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

****
NOTE: A packaged air handling unit specification is included later in this section to be matched with this equipment.
****

****
NOTE: Multiple condensing units may be paired with one air-handling unit on larger systems. For example: an 88 kW system may consist of one air handling unit, one direct expansion coil, one 35 kW heat pump and one 53 kW heat pump. For systems larger than 27 kW operating to serve a variable load the designer should consider multiple condensing units.
****

Factory assembled and tested, electrically controlled, air-cooled split system heat pump unit, designed for exterior installation. Unit shall function as the outdoor component of an air-to-air electric heat pump system.

a. Unit shall be used in a refrigerant circuit matched with a packaged air-handling unit, as approved by the manufacturer.

b. Outdoor mounted, air-cooled split system heat pump unit shall be suitable for on the ground or rooftop installation on a full level pad or on raised pads at each support point. The unit shall consist of a compressor, fin-tube coil, propeller type fan, fan motor, refrigeration control devices, and a control box. All components shall be factory assembled as a single unit.

c. A holding charge of R-407-C shall be included.

[d. Multiple condensing units may be used with one air-handling unit on larger systems.]

2.5.1 Unit Cabinet

Galvanized steel construction with enamel paint finish.

a. Fan venturi housings and guards shall be assembled on the unit.

b. A removable panel shall be provided for access to compressor and control compartments.

c. Lifting holes shall be provided to facilitate rigging.

[d. A refrigerant accumulator with a fusible plug relief shall be installed in the cabinet, if required by the manufacturer to achieve the scheduled performance.]

2.5.2 Fans

Propeller type, aluminum blades fastened to corrosion resistant steel body, direct drive, dynamically balanced.

a. Fan motor shall be totally enclosed type with permanently lubricated bearings and thermal overload protection.

b. Fan shall be arranged for vertical discharge.

2.5.3 Compressor/Motor Assembly

Compressor motors shall be refrigerant cooled type with thermal and current overload protection.

a. Oil pump shall be automatically reversible.

b. Casing shall include discharge shutoff valves and a crankcase oil heater.

c. Compressor assembly shall be installed on spring vibration isolators.

2.5.4 Refrigerant Coils

Coil shall have copper tubes, aluminum plate fins, and galvanized steel tube sheets. The fins shall be bonded to tubes by mechanical expansion. Coil shall be circuited for sub-cooling in cooling mode operation.

a. For refrigerant control, the unit shall be equipped with a liquid line, suction line, and compressor discharge service valves.

b. The unit shall include a reversing valve for effective heat pump operation.

c. Provide an accumulator with fusible plug relief if required by the manufacturer.

d. Provide each system with 3 service ports: one on the suction line, one on the liquid line, and one on the compressor discharge line. Each port shall be capped for leak tightness.

2.5.5 Controls and Safeties

Operating controls and safeties shall be factory selected, assembled, and tested. Minimum control functions shall be as listed below:

2.5.5.1 Controls

a. Time delay restart control to prevent compressor short-cycling.

b. Defrost control to consist of a time and temperature activated system that initiates defrost mode at selectable intervals of 30, 50, or 90 minutes in response to a temperature signal.

2.5.5.2 Safeties

a. High discharge pressure cutout switch.

b. Loss-of-charge cutout switch.

c. Compressor motor current and temperature overload cutouts.

d. 5 minute recycle protection to prevent compressor short cycling.

e. Device to hold the compressor off-line until manual reset at the thermostat when any of the following are tripped: High discharge pressure, high compressor motor temperature, or loss of charge.

2.5.6 Electrical Requirements

Factory supplied and installed transformer shall provide 24V control voltage. All power and control circuit wiring shall comply with local and national codes.

[2.5.7 Optional Features

[2.5.7.1 Head Pressure Control

Control shall vary the fan motor speed in response to the saturated condensing temperature of the unit. The control shall be capable of maintaining a condensing temperature of 38 deg. C plus or minus 12 deg. C with outdoor temperature at -28 deg. C.

][2.5.7.2 Outdoor Thermostat

Adjustable control shall activate electric heaters in stages to provide supplemental heat. Range: -34 deg. C to 32 deg. C.

][2.5.7.3 Disconnect Switch

Provide field installed, unit mounted disconnect switch.

][2.5.7.4 24V Thermostat and Subbase

Thermostat/subbase shall provide control of space temperature by allowing selection of heating or cooling, and continuous or automatic fan operation.

][2.5.7.5 Communicating Electronic Thermostat

Electronic programmable thermostat assemblies shall provide 2-stage heating and 2-stage cooling control with remote communication ability and shall be factory supplied for field installation.

][2.5.7.6 Coil Guard

Grille shall protect condenser coil from damage by large objects or vandalism.

][2.5.7.7 Hail Guard

Guard shall protect unit against damage from damage by hail or flying debris.

][2.5.7.8 Copper-Fin Coils

****
NOTE: This option is not available from all manufacturer's. The designer shall research availability before including this option.
****

Condenser coil shall be constructed of copper fins mechanically bonded to copper tubes and copper tube sheets. Galvanized steel tube sheets shall not be acceptable. A polymer strip shall prevent coil assembly from contacting sheet metal coil pan to minimize potential for galvanic corrosion between the coil and pan. All copper construction shall provide protection in moderate coastal applications.

][2.5.7.9 Condenser Coil Coating

Provide phenolic epoxy corrosion-protection coating to condenser coils.

]]2.5.8 Thermostat Control

****
NOTE: Select one of the following choices.
****

[Programmable multi-stage thermostat with 7 day clock, holiday scheduling, large backlit display, and remote sensor capability.]

[Programmable communicating multi-stage thermostat with fan switch, time

clock, LCD display, degrees C capability, and DDC compatibility.]

[Commercial electronic thermostat with 7 day time clock, auto-changeover, multi-stage capability, and large LCD temperature display.]

[Non-programmable thermostat with fan switch subbase.]

2.6 PACKAGED HEAT PUMP, 21 kW to 88 kW CAPACITY

****
NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

Factory assembled and tested, single piece, air-to-air heat pump; designed for exterior installation. Complete with compressor, indoor and outside refrigerant coils, indoor (evaporator) fan and outside (condenser) fan, refrigeration and temperature controls, filters, dampers, and factory wiring and piping.

2.6.1 Unit Cabinet

Galvanized steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts.

a. Insulate internal cabinet surfaces with minimum 13 mm thick thermal insulation coated on the air side so insulation material will not delaminate when exposed to the air stream.

b. Unit shall include sloped non-corrosive drain pan with minimum 20 mm external condensate piping connection.

c. Furnish with knockouts for electrical and piping connections, and exterior condensate drain connection.

d. Furnish unit with base rails. Provide base rails with holes or lifting lugs to facilitate overhead rigging.

2.6.2 Indoor (Evaporator) Fan

Indoor blower shall be of the direct- or belt-driven, double inlet, forward curved centrifugal type. Belt drive shall include an adjustable pitch motor pulley. Indoor blower shall be made from steel with a corrosion resistant finish and shall be dynamically balanced.

2.6.3 Outside (Condenser) Fan

Propeller type, aluminum blades riveted to corrosion resistant steel body, direct drive motor, dynamically balanced.

2.6.4 Motors

Compressor motors shall be refrigerant cooled type with thermal and current overload protection. Furnish fan motors with permanently lubricated bearings and thermal overload protection. Outdoor (condenser) fan motor shall be totally enclosed type.

2.6.5 Refrigerant Coils

Aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Steel coil casing with equalizing type vertical distributor. [Provide phenolic epoxy corrosion protection coating to condenser [and evaporator] coils.]

2.6.6 Compressors

Provide [One compressor.] [2 compressors.] [quantity as indicated on equipment schedule.] Manufacturer's standard hermetic compressor with integral vibration isolators, internal pressure relief[, and crankcase heater].

2.6.7 Refrigeration System

Shall include, but not be limited to, the following components:

a. Compressor(s).

b. Outside (condenser) coil and fan.

c. Indoor (evaporator) coil and fan.

d. 4-way reversing valve[and suction line accumulator, if required by the manufacturer].

e. Check valves.

f. Expansion valves with replaceable thermostatic elements.

g. Refrigerant dryers.

h. High pressure switches.

i. Low pressure switches.

j. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.

k Independent refrigerant circuits on units 26.4 kW and larger.

l. Brass service valves installed in discharge and liquid lines.

m. Charge of refrigerant.

n. Timed Off Control: Automatic reset control shuts compressor off after 5 minutes.

2.6.8 Filters

Standard filter section shall consist of factory installed low-velocity, throwaway 50 mm thick fiberglass filters of commercially available sizes. Filter face velocity shall not exceed 1.5 m/s at nominal airflows. Filters shall be accessible through an access panel with "no-tool" removal.

2.6.9 Electric Heat

Helix wound, nickel-chrome, electric resistance elements, factory wired for single point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices.

****

NOTE: Select either the outdoor air damper or the economizer.

****

[2.6.10 Outside Air Damper

[a. Linked damper blades, for 0 to 25 percent outside air, bird screen, and hood.]

[b. Fully modulating, spring return damper motor, bird screen, and hood.]

][2.6.11 Economizer

Return and outside air dampers with neoprene seals, outside air filter, and hood.

a. Damper Motor: Fully modulating spring return with adjustable minimum position.

b. Control: Electronic control system uses [outside air temperature] [mixed air and outside air temperature] [outside air enthalpy] to adjust mixing dampers.

c. Relief Damper: Gravity actuated with bird screen and hood.

]2.6.12 Power Connection

Provide for single connection of power to unit with [unit mounted disconnect switch accessible from outside unit and] control circuit transformer with built-in circuit breaker.

2.6.13 Operating Characteristics

Unit shall be capable of starting and running at 46 deg. C ambient outdoor temperature. Compressor with standard controls shall be capable of operation down to 4.4 deg. C ambient outdoor temperature. Compressor shall be capable of operation in heating duty down to 23 deg. C ambient outdoor air temperature. Unit shall be capable of simultaneous heating duty and defrost cycle operation when auxiliary [gas] [electric] heat.

2.6.14 Unit Controls

****

NOTE: Careful consideration shall be given to Unit Controls. Many of these items are readily available for systems larger than 70kW. For smaller systems these items may add significant cost to the equipment.

****

Complete with self contained low voltage control circuit and components to contain at least the following features:

a. Indoor fan on/off delay.

b. Default control to ensure proper operation after power interruption.

c. Service relay output.

d. Field adjustable control parameters.

e. Defrost control.

f. Electric heat staging.

g. Low refrigerant pressure control.

[h. Unit diagnostics and diagnostic code storage.]

[i. Economizer control.]

[j. Indoor air quality control with carbon dioxide sensor.]

[k. Low ambient control, allowing operation down to minus 18 deg C.]

[l. Minimum run time.]

[m. Night setback mode.]

[n. Return air temperature limit.]

[o. Digital display of outside temperature, supply air temperature, return air temperature, economizer damper position, indoor air quality, and control parameters.]

****

Note: Select control options from following 3 paragraphs. Control options shall be coordinated with existing base controls and project budget.

****

[2.6.15 DDC

Install stand alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature control system specified in Section 15910, "Direct Digital Control System."

][2.6.16 Electromechanical Thermostat

Staged heating and cooling on subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

a. Night setback operation with single stage heating control with [7 day] [24 hour] time clock with battery backup.

b. Fan proving switch to lock out unit if fan fails.

c. Dirty filter switch.

d. LED to indicate when Auxiliary Heat is activated.

][2.6.17 Thermostat

Programmable, electronic; with heating setback and cooling setup with 7 day programming. Compatible with all standard 24V AC heat pump systems. Provide with the following features:

a. Control of up to 2 stage heat and 2 stage cool.

b. Multi-colored LEDs indicate system status with Auxiliary (green), Check (red), and Emergency Heat (red).

c. 24V powered with battery back-up.

d. Adjustable 1st and 2nd stage differential.

e. Automatic switching.

f. Deg C readout.

g. 24 hour/day programming, not less than 4 schedules per day.

h. Manual override capability.

i. Time and operational mode readout.

j. Status indicator.

k. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

l. Fan-proving switch to lock out unit if fan fails.

m. Dirty filter switch.

][2.6.18 Optional Accessories

[a. Service Outlets: One duplex receptacle, 220V, ground-fault, circuit-interrupter type, protected from weather.]

[b. Dirty filter switch.]

[c. Coil guards of painted, galvanized steel wire.] [Hail guards of steel, painted to match casing.]

[d. [Step-down] [Flush] diffuser with aluminum grilles, insulated diffuser box with flanges, and interior transition.]

[e. Power exhaust fan[, propeller] [, centrifugal] type.]

[f. Vertical vent extension.]

]2.6.19 Roof Curb

Steel with corrosion-protection coating, gasketing, and factory installed wood nailer; minimum height of [350] [600] [___] mm.

2.6.20 Horizontal Discharge Roof Curb

Steel with corrosion protection coating, [insulation,] gasketing, and factory installed wood nailer, and configured to convert from downflow to horizontal airflow; minimum height of [660] [760] [940] [1040] [___] mm.

2.6.21 Isolation Curb

Rigid upper and lower steel structure with vibration isolation springs having [50] [___] mm static deflection and vertical and horizontal restraints; with elastomeric waterproof membrane.

2.7 SPLIT SYSTEM AIR CONDITIONING UNIT, 18kW AND SMALLER

****
NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

Split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

2.7.1 Concealed Evaporator-Fan Components

2.7.1.1 Chassis

Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

a. Insulation: Faced, glass-fiber duct liner.

b. Drain Pans: Corrosion protected steel or PVC, with connection for drain; insulated.

c. Suitable for vertical or horizontal mounting.

2.7.1.2 Refrigerant Coils

Copper tube, with mechanically bonded aluminum fins and with thermal expansion valve or orifice. Tubes shall be cleaned, dehydrated, and sealed. Coils shall be factory pressure and leak tested.

2.7.1.3 Electric Coil

Helical, nickel-chrome, resistance wire heating elements with refractory ceramic support bushings; automatic reset thermal cutout; built-in magnetic contactors; manual reset thermal cutout; airflow proving device; and one time fuses in terminal box for overcurrent protection.

2.7.1.4 Fan

Forward curved, double width wheel of galvanized steel; directly connected to motor.

2.7.1.5 Fan Motor

Multispeed, PSC type.

2.7.1.6 Disposable Filters

25 mm thick, in fiberboard frames.

2.7.1.7 Wiring Terminations

Connect motor to chassis wiring with plug connection.

2.7.2 Ductless Evaporator-Fan Components

Provide [wall mounted] [or] [ceiling mounted] ductless evaporator-fan components.

2.7.2.1 Cabinet

Enameled steel with removable panels on front and ends, and discharge drain pans with drain connection.

2.7.2.2 Refrigerant Coils

Copper tube, with mechanically bonded aluminum fins and with thermal expansion valve or orifice. Tubes shall be cleaned, dehydrated, and sealed. Coils shall be factory pressure and leak tested.

2.7.2.3 Electric Coil

Helical, nickel-chrome, resistance-wire heating elements with refractory

ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one time fuses in terminal box for overcurrent protection.

2.7.2.4 Fan and Motor

Centrifugal fan, directly driven by multispeed, electric motor with integral overload protection; resiliently mounted.

2.7.2.5 Filters

Permanent, cleanable.

2.7.3 Air-Cooled, Compressor-Condenser Components

2.7.3.1 Casing

Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2.7.3.2 Compressor

Hermetically sealed and mounted on vibration isolation. Furnish with oil system, operating charge, and motor. Compressor motor shall have thermal and current sensitive overload devices, start capacitor, relay, and contactor. Motor shall be suitable for operation in a refrigerant atmosphere.

a. Compressor Type: Reciprocating or scroll.

b. Compressor motor with manual reset high pressure switch and automatic reset low pressure switch.

[c. Crankcase Heater: Provide unit with compressor oil sump heater.]

2.7.3.3 Refrigerant Coils

Copper tube, with mechanically bonded aluminum fins and with liquid subcooler. Tubes shall be cleaned, dehydrated, and sealed. Coils shall be factory pressure and leak tested. [Provide phenolic epoxy corrosion protection coating to condenser [and evaporator coils.]]

2.7.3.4 Refrigeration Components

Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulator (if required by manufacturer), bi-flow filter drier, pressure relief, reversing valve, heating mode metering device, and low temperature air cut-off thermostat.

2.7.3.5 Fan

Aluminum propeller type, directly connected to motor.

2.7.3.6 Motor

Permanently lubricated, with integral thermal overload protection.

2.7.3.7 Operating Characteristics

Unit shall be capable of starting and running at 46 degrees C ambient outdoor temperature. Compressor with standard controls shall be capable of operation down to 12.7 degrees C ambient outdoor temperature.

2.7.3.8 Controls and Safeties

Operating controls and safeties shall be factory selected, assembled, and tested. The minimum functions shall include the following:

a. Controls:

1) Time delay restart to prevent compressor reverse rotation on single phase scroll compressors.

2) Automatic restart on power failure.

3) Safety lockout if any outdoor unit safety is open.

4) A time delay control sequence is also provided standard through the fan coil board, thermostat, or controller.

5) High pressure and liquid line low pressure switches.

6) Automatic outdoor fan motor protection.

7) Start capacitor and relay (single phase units without scroll compressors).

b. Safeties:

1) System diagnostics.

2) Compressor motor current and temperature overload protection.

3) High pressure relief.

4) Outdoor fan failure protection.

c. Electrical Requirements:

1) Unit shall operate on single phase, 50 Hz power at 220 volts.

2) Unit electrical power shall be a single point connection.

3) Provide unit control voltage to the indoor fan coil.

4) Unit shall have high and low voltage terminal block connections.

****

NOTE: When the split system equipment is required to provide cooling at outside air temperatures below 12.7 degrees C, the low ambient kit should be specified for the equipment. The Liquid Solenoid Valve should be specified with all long-refrigerant lines applications (over 30 meters).

****

d. Special Features (Field Installed):

[1) Low Ambient Kit: Control shall regulate fan-motor cycles in response to saturated condensing pressure of the unit. The control shall be capable of maintaining a condensing temperature of 37.8 degrees C ± 5.5 with outdoor temperatures to - 17.8 degrees C.]

[2) Liquid Solenoid Valve: This electronically operated shutoff valve shall close and open in response to compressor operation.]

2.7.4 Accessories

[2.7.4.1 Thermostat

Low voltage with subbase to control compressor and evaporator fan. Provide with temperature indication and adjustment, fan "on-auto", and "heat-off-cool" functions. provide emergency heat control and indication when provided. Thermostat shall include and automatic reset timer to prevent rapid cycling of compressor.

][2.7.4.2 Thermostat

****

NOTE: The wireless infared option is only available with some ductless evaporator-fan options. Coordinate for availability before using this option.

****

Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

a. Compressor time delay.

b. 24 hour time control of system stop and start.

c. Liquid crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

d. Fan speed selection, including auto setting.

]2.7.4.3 Refrigerant Line Kits

Soft annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory insulated suction line with flared fittings at both ends.

2.8 PACKAGED AIR CONDITIONING UNIT, 18 kW AND SMALLER

****
NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

Factory assembled and tested, single piece, air-to-air straight cool air-conditioning unit; designed for exterior installation. Complete with compressor, indoor and outside refrigerant coils, indoor (evaporator) fan and outside (condenser) fan, refrigeration and temperature controls, filters, dampers, and factory wiring and piping.

2.8.1 Unit Cabinet

Steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts

a. Insulate internal cabinet surfaces with minimum 13 mm thick thermal insulation coated on the air side so insulation material will not delaminate when exposed to the air stream.

b. Unit shall include sloped non-corrosive drain pan with external condensate piping connection.

c. Furnish with knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

2.8.2 Indoor (Evaporator) Fan

Forward curved, centrifugal, [belt driven] [or] [directly driven by multi-speed motor]. Steel fan wheel with corrosion resistant finish, double inlet type, and dynamically balanced.

2.8.3 Outside (Condenser) Fan

Propeller type, aluminum blades riveted to corrosion resistant steel body, direct drive motor, dynamically balanced.

2.8.4 Motors

Compressor motors shall be refrigerant cooled type with thermal and current overload protection. Furnish fan motors with permanently lubricated bearings and thermal overload protection. Outdoor (condenser) fan motor shall be totally enclosed type.

2.8.5 Refrigerant Coils

Aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Steel coil casing with equalizing type vertical distributor. Tubes shall be cleaned, dehydrated, and sealed. Factory pressure and leak test coils. [Provide phenolic epoxy corrosion protection coating to condenser [and evaporator] coils.]

2.8.6 Compressor

Manufacturer's standard hermetic compressor with integral vibration isolators and internal pressure relief. Furnish with oil system, operating charge, and motor. Compressor motor shall have thermal and current sensitive overload devices; start capacitor, relay, and contactor. Motor shall be suitable for operation in refrigerant atmosphere. [Provide with compressor oil sump heater.]

2.8.7 Refrigeration System

Shall include, but not be limited to the following components:

a. Compressor.

b. Outside (condenser) coil and fan.

c. Indoor (evaporator) coil and fan.

d. 4-way reversing valve[and suction line accumulator if required by manufacturer].

e. Expansion valve.

f. Refrigerant type.

g. High pressure switch.

h. Low pressure switch.

i. Thermostat for coil freeze up protection during low ambient temperature operation or loss of air.

j. Low ambient switch.

k. Brass service valves installed in discharge and liquid lines.

l. Charge of refrigerant.

2.8.8 Filters

Provide filters of the type specified in this section.

****

NOTE: Designer shall select one or none of the

following 2 heating methods.
****

[2.8.9 Heat Exchanger

[Aluminized steel] [Stainless steel] construction for [natural] [propane]-gas-fired burners with the following controls:

a. Redundant single or dual gas valve with manual shutoff.

b. Direct-spark pilot ignition.

c. Electronic flame sensor

d. Induced draft blower.

e. Flame roll out switch.

][2.8.10 Electric Heat

Helix wound, nickel-chrome, electric resistance elements, factory wired for single point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices. Heater elements shall be adequately supported and insulated with ceramic bushings. Provide capacity and characteristics as indicated in equipment schedule.

****
NOTE: Select either the outdoor air damper or the economizer.
****

][2.8.11 Outside Air Damper

[a. Linked damper blades, for 0 to 25 percent outside air, bird screen, and hood.]

[b. Fully modulating, spring return damper motor, bird screen, and hood.]

][2.8.12 Economizer

Return and outside air dampers with neoprene seals, outside air filter, and hood.

a. Damper Motor: Fully modulating spring return with adjustable minimum position.

b. Control: Electronic control system uses [outside air temperature] [mixed air and outside air temperature] [outside air enthalpy] to adjust mixing dampers.

c. Relief Damper: Gravity actuated with bird screen and hood.

]2.8.13 Power Connection

Provide for single connection of power to unit with [unit mounted disconnect switch accessible from outside unit and] control circuit transformer with built-in circuit breaker.

2.8.14 Operating Characteristics

Unit shall be capable of starting and running at 46 degrees Celsius ambient outdoor temperature. Compressor with standard controls shall be capable of operation down to 4.4 degrees Celsius ambient outdoor temperature.

****
Note: Select control options from following 3 paragraphs. Control options shall be coordinated with existing base controls and project budget.
****

[2.8.16 DDC

Install stand alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Section 15910, "Direct Digital Control Systems."

][2.8.17 Electromechanical Thermostat

Staged heating and cooling on subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

a. Night setback operation with single stage heating control with [7 day] [24 hour] time clock with battery backup.

b. Fan proving switch to lock out unit if fan fails.

c. Dirty filter switch.

][2.8.18 Thermostat

Programmable, electronic; with heating setback and cooling setup with 7 day programming; and the following:

a. Touch sensitive keyboard.

b. Automatic switching.

c. Deg C readout.

d. LED indicators.

e. Hour/day programming.

f. Manual override capability.

g. Time and operational mode readout.

h. Status indicator.

i. Battery backup.

j. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

k. Fan proving switch to lock out unit if fan fails.

l. Dirty filter switch.

][2.8.19 Optional Accessories

[a. Low Ambient Package: solid state control and condenser coil temperature sensor for controlling outdoor (condenser) fan motor operation, which shall allow unit to operate down to minus 17 degrees Celsius outdoor ambient temperature.]

[b. Service Outlets: One duplex receptacle, 220V, ground fault, circuit interrupter type, protected from the weather.]

[c. Dirty filter switch.]

[d. [Coil guards of painted, galvanized steel wire] [Hail guards of steel, painted to match casing]].

[e. [Step down] [Flush] diffuser with aluminum grilles, insulated diffuser box with flanges, and interior transition.]

]2.8.20 Roof Curb

Steel with corrosion protection coating, gasketing, and factory installed wood nailer; minimum height of [350] [600] [___] mm.

2.9 SPLIT SYSTEM AIR CONDITIONING UNIT, 21 kW AND LARGER

****
NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

****
NOTE: A packaged air handling unit specification is included later in this section to be matched with this equipment.
****

****
NOTE: Multiple condensing units may be paired with one air-handling unit on larger systems. For example: an 88 kW system may consist of one air handling unit, one direct expansion coil, one 35 kW heat pump and one 53 kW heat pump. For systems

larger than 27 kW operating to serve a variable load the designer should consider multiple condensing units.

****

Factory-assembled and tested, electrically controlled, single piece, air-cooled condensing unit, designed for exterior installation. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge, and special features required prior to field start-up.

a. Unit shall function as the outdoor component of an air-to-air electrical air conditioning system. Unit shall be used in a refrigerant circuit matched with a packaged air-handling unit as approved by the manufacturer.

b. Outdoor mounted, air-cooled condensing unit shall be suitable for on the ground or rooftop installation on a full level pad or on raised pads at each support point. The unit shall consist of a compressor, fin tube coil, propeller type fan, fan motor, refrigeration control devices, and a control box. All components shall be factory assembled as a single unit.

c. A holding charge of R-407-C shall be included.

[d. Multiple condensing units may be used with one air-handling unit on larger systems.]

2.9.1 Unit Cabinet

Galvanized steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts.

a. Provide with heavy gage roll formed perimeter base rail with forklift slots and lifting holes to facilitate rigging.

b. Fan venturi housings and guards shall be assembled on the unit.

c. A removable panel shall be provided for access to compressor and control compartments.

[d. A refrigerant accumulator with fusible plug relief shall be installed in the cabinet, if required by the manufacturer to achieve the scheduled performance.]

2.9.2 Fans

Condenser fans shall be direct driven, propeller type with aluminum blades fastened to corrosion resistant steel body, discharging air vertically upward.

a. Fan blades shall be dynamically balanced.

b. Condenser fan discharge openings shall be equipped with corrosion resistant steel wire safety guards.

c. Condenser fan and motor shaft shall be corrosion resistant.

2.9.3 Compressor/motor assembly

Compressors shall be of the hermetic scroll or reciprocating type, mounted on vibration isolators.

a. Compressors shall include overload protection.

b. Compressors shall be equipped with a crankcase heater.

2.9.4 Condenser Coil

Condenser coil shall be air-cooled and circuited for integral sub-cooler, constructed of aluminum fins mechanically bonded to internally grooved seamless copper tubes, which are then cleaned, dehydrated, and sealed.

2.9.5 Refrigeration Components

Refrigeration circuit components shall include liquid line service valve, suction line service valve, a full charge of compressor oil, and a holding charge of refrigerant. Provide 3 service ports; one on the suction line, one on the liquid line, and one on the compressor discharge line. Each port shall be capped for leak tightness.

2.9.6 Controls and Safeties

Operating controls and safeties shall be factory selected, assembled, and tested. Provide the following minimum control and safety functions:

a. Time delay restart control to prevent compressor short cycling.

b. Control wire terminal blocks.

c. Compressor lockout on auto reset safety until reset from thermostat.

d. High discharge pressure cutout switch.

e. Loss of charge cutout switch.

2.9.7 Electrical Requirements

Unit electrical power shall be single point connection and shall contain a 24 volt transformer for unit control.

[2.9.8 Optional Features

[2.9.8.1 Low Ambient Temperature Control

Provide as a factory installed option or as a field installed accessory.

This low ambient control shall regulate speed of the condenser-fan motors in response to the saturated condensing temperature of the unit. The control shall maintain correct condensing pressure at outdoor temperatures down to -29 deg. C.

][2.9.8.2 Hail Guard Package

Hail guard package shall protect coils against damage from hail and other flying debris.

][2.9.8.3 Non-Fused Disconnect Switch

Factory installed, internally mounted, NEC and UL approved non-fused switch shall provide unit power shutoff. Shall be accessible from outside the unit and shall provide power off lockout capability.

]][2.9.9 Copper-Fin Coils

Condenser coils shall be constructed of copper fins mechanically bonded to copper tubes and copper tube sheets. Galvanized steel tube sheets shall not be acceptable. A polymer strip shall prevent coil assembly from contacting sheet metal coil pan to minimize potential for galvanic corrosion between the coil and pan. All copper construction shall provide protection in moderate coastal environments.

][2.9.10 Condenser Coil Coating

Provide phenolic epoxy corrosion protection coating to condenser coils.

]2.9.11 Thermostat Control

****
NOTE: Select one of the following choices.
****

[Programmable multi-stage thermostat with 7 day clock, holiday scheduling, large backlit display, and remote sensor capability.]

[Programmable communicating multi-stage thermostat with fan switch, time clock, LCD display, degree C capability, and DDC compatibility.]

[Commercial Electronic Thermostat with 7 day time clock, auto changeover, multi-stage capability, and large LCD temperature display.]

[Non-programmable thermostat with fan switch subbase.]

2.10 PACKAGED AIR CONDITIONING UNIT, 21 kW AND LARGER

****
NOTE: Equipment efficiency shall be in accordance with ASHRAE 90.1 with actual energy efficiency ratio (EER) as scheduled on drawings with equipment.
****

Factory assembled and tested, single piece, air-to-air straight cool air-conditioning unit; designed for exterior installation. Complete with compressor, indoor and outside refrigerant coils, indoor (evaporator) fan and outside (condenser) fan, refrigeration and temperature controls, filters, dampers, and factory wiring and piping.

2.10.1 Unit Cabinet

Steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts.

a. Insulate internal cabinet surfaces with minimum 13 mm thick thermal insulation coated on the air side so insulation material will not delaminate when exposed to the air stream.

b. Unit shall include sloped non-corrosive drain pan with external condensate piping connection.

c. Furnish with knockouts for electrical and piping connections and exterior condensate drain connection.

d. Furnish unit with base rails. Provide base rails with holes or lifting lugs to facilitate overhead rigging.

2.10.2 Indoor (Evaporator) Fan

Forward curved, centrifugal, belt driven or directly driven by multi-speed motor as shown on equipment schedule. Steel fan wheel with corrosion resistant finish, double inlet type, and dynamically balanced. Belt drive shall include an adjustable pitch motor pulley.

2.10.3 Outside (Condenser) Fan

Propeller type, aluminum blades riveted to corrosion resistant steel body, direct drive motor, dynamically balanced.

2.10.4 Motors

Compressor motors shall be refrigerant cooled type with thermal and current overload protection. Furnish fan motors with permanently lubricated bearings and thermal overload protection. Outdoor (condenser) fan motor shall be totally enclosed type.

2.10.5 Refrigerant Coils

Aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Steel coil casing with equalizing type vertical distributor. [Provide phenolic epoxy corrosion protection coating to condenser [and evaporator] coils.]

2.10.6 Compressor

Provide [one compressor.] [2 compressors.] [quantity as indicated on equipment schedule], manufacturer's standard hermetic compressors with

integral vibration isolators and internal pressure relief [, and crankcase heater].

2.10.7 Refrigeration System

Shall include, but not be limited to, the following components:

a. Compressor(s).

b. Outside (condenser) coil and fan.

c. Indoor (evaporator) coil and fan.

d. 4-way reversing valve[and suction line accumulator if required by the manufacturer].

e. Check valves.

f. Expansion valves with replaceable thermostatic elements.

g. Refrigerant dryers.

h. High pressure switches.

i. Low pressure switches.

j. Thermostats for coil freeze-up protection during low ambient temperature operation or loss of air.

k. Independent refrigerant circuits on units 26.4 kW and larger.

l. Brass service valves installed in discharge and liquid lines.

m. Charge of refrigerant.

n. Timed Off Control: Automatic reset control shuts compressor off after 5 minutes.

2.10.8 Filters

Provide filters of the type specified in this section.

****
NOTE: Designer shall select one or none of the following 2 heating methods.
****

[2.10.9 Heat Exchanger

[Aluminized steel] [Stainless steel] construction for [natural] [propane]-gas-fired burners with the following controls:

a. Redundant dual gas valve with manual shutoff.

b. Direct spark pilot ignition.

c. Electronic flame sensor.

d. Induced draft blower.

e. Flame roll out switch.

][2.10.10 Electric Heat

Helix wound, nickel-chrome, electric resistance elements, factory wired for single point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices. Heater elements shall be adequately supported and insulated with ceramic bushings. Provide capacity and characteristics as indicated in equipment schedule.

****
NOTE: Select either the outdoor air damper or the economizer.
****

][2.10.11 Outside Air Damper

[a. Linked damper blades, for 0 to 25 percent outside air, bird screen, and hood.]

[b. Fully modulating, spring return damper motor, bird screen, and hood.]

][2.10.12 Economizer

Return and outside air dampers with neoprene seals, outside air filter, and hood.

a. Damper Motor: Fully modulating spring return with adjustable minimum position.

b. Control: Electronic control system uses [outside air temperature] [mixed air and outside air temperature] [outside air enthalpy] to adjust mixing dampers.

c. Relief Damper: Gravity actuated with bird screen and hood.

]2.10.13 Power Connection

Provide for single connection of power to unit with [unit mounted disconnect switch accessible from outside unit and] control circuit transformer with built-in circuit breaker.

2.10.14 Operating Characteristics

Unit shall be capable of starting and running at 46 degrees Celsius ambient outdoor temperature. Compressor with standard controls shall be capable of operation down to 4.4 degrees Celsius ambient outdoor temperature.

2.10.15 Unit Controls

****

NOTE: Give careful consideration to Unit Controls. Many of these items are readily available for systems 70 kW and larger but for smaller systems these items may add significant cost to the equipment.

****

Solid-state control board and components contain at least the following features:

a. Indoor fan on/off delay.

b. Default control to ensure proper operation after power interruption.

c. Service relay output.

d. Field adjustable control parameters.

e. Defrost control.

f. Low refrigerant pressure control.

[g. Unit diagnostics and diagnostic code storage.]

[h. Dehumidification control with dehumidistat.]

[i. Economizer control.]

[j. Electric heat staging.]

[k. Gas valve delay between first and second stage firing.]

[l. Indoor air quality control with carbon dioxide sensor.]

[m. Low ambient control, allowing operation down to minus 18 deg C.]

[n. Minimum run time.]

[o. Night setback mode.]

[p. Return air temperature limit.]

[q. Digital display of outside temperature, supply air temperature, return air temperature, economizer damper position, indoor air quality, and control parameters.]

****

NOTE: Variable-air-volume control is available for systems of capacity 70 kW and larger.

****

[r. Variable-Air-Volume Control: Variable frequency drive controls supply air static pressure. [Supply air, static pressure limit shuts unit down on high pressure.]]

****

Note: Select control options from following 2 paragraphs. Control options shall be coordinated with existing base controls and project budget.

****

[2.10.16 DDC Temperature Control

Install stand alone control module providing link between unit controls and DDC temperature control system. Control module shall be compatible with temperature control system specified in Section 15910, "Direct Digital Control System."

][2.10.17 Thermostat

Programmable, electronic; with heating setback and cooling setup with 7 day programming; and the following:

a. Touch sensitive keyboard.

b. Automatic switching.

c. Deg C readout.

d. LED indicators.

e. Hour/day programming.

f. Manual override capability.

g. Time and operational mode readout.

h. Status indicator.

i. Battery backup.

j. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

k. Fan proving switch to lock out unit if fan fails.

l. Dirty filter switch.

][2.10.18 Optional Accessories

[a. Cold Weather Kit: Electric heater maintains temperature in gas burner compartment.]

[b. Service Outlets: One duplex receptacle, 220V, ground fault, circuit interrupter type, protected from the weather.]

[c. Dirty filter switch.]

[d. [Coil guards of painted, galvanized steel wire.] [Hail guards of steel, painted to match casing.]]

[e. [Step down] [Flush] diffuser with aluminum grilles, insulated diffuser box with flanges, and interior transition.]

[f. Power exhaust fan[, propeller] [, centrifugal] type.]

]2.10.19 Roof Curb

Steel with corrosion-protection coating, gasketing, and factory installed wood nailer; minimum height of [350] [600] [___] mm.

2.10.20 Horizontal Discharge Roof Curb

Steel with corrosion protection coating, [insulation,] gasketing, and factory installed wood nailer, and configured to convert from downflow to horizontal airflow; minimum height of [660] [760] [940] [1040] [___] mm.

2.10.21 Isolation Curb

Rigid upper and lower steel structure with vibration isolation springs having [50] [___] mm static deflection and vertical and horizontal restraints; with elastomeric waterproof membrane.

2.11 PACKAGED AIR HANDLING UNIT

****
NOTE: For larger systems, systems with external static pressure requirements greater than 250 Pascals, or systems requiring an air handling unit with more options, delete the following and use Section 15720, "Air Handling Units".
****

Indoor mounted, draw-thru, packaged air-handling unit that can be used in a suspended horizontal configuration or a vertical configuration. Unit shall consist of forward curved belt-driven centrifugal fan(s), motor and drive assembly, prewired fan motor contactor, factory installed refrigerant metering devices (direct-expansion coil units), cooling coil, 50 mm disposable air filters, and condensate drain pans for vertical or horizontal configurations. Unit shall function as the indoor component of an air-to-air electric [air conditioning] [and] [heat pump] system. Unit shall be used in a refrigerant circuit matched with a condensing unit as approved by the manufacturer.

2.11.1 Base Unit

Cabinet shall be constructed of [mill galvanized steel] [,] [corrosion

resistant steel] [or] [corrosion resistant steel with enamel paint finish]. Cabinet panels shall be fully insulated with 12.7 mm fire retardant material. Insulation shall contain an immobilized antimicrobial agent to effectively resist the growth of bacteria and fungi as proven by tests in accordance with UNI EN ISO 846.

2.11.1.1 Condensate Drain Pans

Unit shall contain condensate drain pans for both vertical and horizontal applications. Drain pans shall have connections on right and left sides of unit to facilitate field connection. Drain pans shall have the ability to be sloped toward the right or left side of the unit to prevent standing water from accumulating in pans. Fabricate drain pans of [PVC] [or] [stainless steel with plastic coating].

2.11.1.2 Filters

Unit shall have factory supplied 50 mm throwaway type filters installed upstream from the cooling coil. Filter access shall be from either the right or left side of the unit.

2.11.2 Coils

Coils shall consist of 3 or 4 rows of copper tubes with aluminum fins bonded to the tubes by mechanical expansion. Suction and liquid line connections or supply and discharge connections shall be made on the same side of the coil.

a. Direct-expansion coils shall feature field or factory installed thermostatic expansion valves (TXVs) for refrigerant control. The TXVs shall be capable of external adjustment.

b. Direct-expansion heat pump coils shall have a field or factory installed bypass line and check valve assembly around the TXVs to allow liquid flow from the coil to the outdoor unit during the heating mode.

c. Coil tubing shall be internally rifled to maximize heat transfer.

2.11.3 Motor

Fan motor of the size and electrical characteristics specified on the equipment schedule shall be factory supplied and installed. Motors rated at 0.97 through 2.76 kW shall have internal thermal overload protection. Motors rated at 3.73, 5.60, and 7.46 kW shall be protected by a circuit breaker.

2.11.4 Factory Installed Options

Provide units with the following:

2.11.4.1 Alternate Motor and Drive

An alternate motor and/or medium- or high-static drive shall be available

to meet the airflow and external static pressure requirements specified on the equipment schedule.

[2.11.4.2 High Capacity Coil

****
NOTE: High capacity coil is an option available only for straight-cool applications. Delete for heat pump applications.
****

The high capacity coil consists of 4 rows of 9.5 mm copper tubes with aluminum fins bonded to the tubes by mechanical expansion. Coil tubing shall be internally rifled to maximize heat transfer. Suction and liquid line connections shall be made on the same side of the coil. Direct-expansion coils shall feature factory-installed thermostatic expansion valves (TXVs) for refrigerant control. The TXVs shall be capable of external adjustment.

][2.11.5 Field Installed Accessories

Provide for the following:

[2.11.5.1 Hot Water Coil

Coil shall be 2 row, U-bend coil with copper tubes and aluminum plate fins bonded to the tubes by mechanical expansion. Coil shall be mounted in a galvanized steel housing that shall be fastened to the unit's fan deck for blow-thru heating operation. Coil shall have maximum working pressure of 1034 kPag.

][2.11.5.2 Steam Distributing Coil

Coil shall consist of one row of copper tubes with aluminum plate fins, and shall have inner steam distributing tubes. Coil shall be mounted in a galvanized steel housing and shall be fastened to the unit's fan deck for blow-thru heating operation. Coil shall have maximum working pressure of 1207 kPag at 204.4 deg. C.

][2.11.5.3 Electric Heaters

Heaters for nominal 240, 480, or 575 Volt, 3 phase, 60 Hz; and 240 or 400 Volt, 3 phase, 50 Hz power supply shall be factory supplied for field installation as shown on the equipment drawings. Electric heat assembly shall be ETL (U.S.A.) and ETL, Canada, agency approved, and shall have single-point power wiring. Heater assembly shall include contactors with 24V coils, power wiring, 24V control wiring terminal blocks, and a hinged access panel. Electric heaters shall not be used with air discharge plenum.

][2.11.5.4 Air Discharge Plenum

Plenum shall be factory supplied to provide free-blow air distribution for vertical floor mounted units. A grille with moveable vanes for horizontal or vertical airflow adjustment shall be included. Plenum shall be field

assembled and field installed on the unit's fan deck for blow-thru air distribution. Plenum shall not be used with electric heaters.

][2.11.5.5 Return-Air Grille

Grille shall be factory supplied for field installation on the unit's return air opening.

][2.11.5.6 Unit Subbase

Subbase assembly shall be factory supplied for field installation. Subbase shall elevate floor mounted vertical units to provide access for correct condensate drain connection.

][2.11.5.7 Economizer

Economizer for ventilation or "free" cooling shall be factory provided for field installation on either return air opening of air handler. For free cooling applications, economizer shall be compatible with separate thermostat; economizer dampers shall open when outdoor air enthalpy is suitable for free cooling. Economizer shall be compatible with separate CO2 sensor accessory; economizer dampers shall open when indoor CO2 level rises above predetermined set point. Economizer shall include enthalpy control and damper actuator.

]]2.12 FILTERS

Provide filters to filter outside air and return air and locate [as indicated] [inside air conditioners] [inside filter box] [inside combination air filter mixing box]. Provide [replaceable (throw-away)] [high efficiency] [cleanable (reusable)] type. Filters shall conform to UL 900, [Class 1] [or] [Class 2]. Polyurethane filters shall not be used on units with multiframe filters.

2.12.1 Replaceable Type Filters

UNI EN 779 throw-away frames and media, standard dust holding capacity, 1.79 m/s maximum face velocity, and [25 mm] thick.

2.12.2 High Efficiency Filters

Filters shall have a mean efficiency of 30 percent when tested in accordance with UNI EN 1822-5. Filter assembly shall include; holding frame and fastener assembly, filter cartridge, mounting frame, and retainer assembly. Reinforce filter media with glass fiber mat. Pressure drop across clean filter shall not exceed [_____] Pa gage. Precede high efficiency filters with a UL Class 2 replaceable type filter.

2.12.3 Manometers

****

NOTE: Prohibit the use of mercury as the operating fluid when air handling units are to be in areas designated as "mercury-free."

****

Provide inclined type manometers for filter stations of 950 L/s capacity or larger including filters furnished as integral parts of air-handling units and filters installed separately. Provide sufficient length to read at least 250 Pa with 10 major graduations, and equipped with spirit level. Equip manometers with overpressure safety traps to prevent loss of fluid, and two 3-way vent valves for checking zero setting. [Mercury shall not be used as the operating fluid.]

2.13 COATINGS FOR FINNED TUBE COILS

****

NOTE: Include this article when coating of finned tube coils is required by the equipment specifications paragraph.

****

****

NOTE: Research project location conditions to determine the environmental effects on finned tube coils. The research should include a survey of existing similar equipment. If needed, rewrite the specifications based on the conclusions of the research. Consideration should be given to the following combinations based on past experience of these materials in dealing with the local conditions.

1. Copper tube and aluminum fins, coated;

2. Copper tube and copper fins, uncoated; and

3. Copper tube and aluminum fins, uncoated.

****

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.13.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by immersion dipping of the entire coil.

2.14 MOTORS AND STARTERS

****

NOTE: Reduced voltage starters should be specified when voltage-regulation problems are anticipated including inadequate power supply, poor distribution

facilities, and presence of electrical or electronic equipment sensitive to voltage fluctuation.

****

Provide manufacturer's standard motor and starter.

2.15 REFRIGERANT PIPING AND ACCESSORIES

****

NOTE: Include and edit this paragraph when refrigerant piping is not included in other project specifications.

****

****

NOTE: For split systems of capacity 18 kW and smaller, this paragraph shall be coordinated with refrigerant line kits specified with the equipment.

****

Provide suction line accumulators as recommended by equipment manufacturer's installation instructions. [Provide a filter-drier in the liquid line.]

2.15.1 Factory Charged Tubing

Provide extra soft, deoxidized, bright annealed copper tubing conforming to UNI 7773-1, factory dehydrated and furnished with a balanced charge of refrigerant recommended by manufacturer of equipment being connected. Factory insulate suction line tubing with 10 mm minimum thickness of closed cell, foamed plastic conforming to UNI 10376with a permeance rating not to exceed 1.0. Provide quick-connectors with caps or plugs to protect couplings. Include couplings for suction and liquid line connections of the indoor and outdoor sections.

2.15.2 Field-Assembled Refrigerant Piping

Material and dimensional requirements for field assembled refrigerant piping, valves, fittings, and accessories shall conform to Law 46, including latest updated revisions, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type K or L, conforming to UNI EN 1057, except that tubing with outside diameters of 6.35 mm and 9.52 mm shall have nominal wall thickness of not less than 7.62 mm and 0.81 mm, respectively. Soft annealed copper tubing conforming to UNI 7773-1 may be used where flare connections to equipment are required only in nominal sizes less than 50 mm outside diameter.

2.15.3 Fittings

UNI EN 1254-1 for solder-joint fittings. UL 109 for flared tube fittings.

2.15.4 Brazing Filler Material

UNI EN 29453.

2.15.5 Pipe Hangers and Supports

UNI 5311 and UNI 7145, except as indicated otherwise.

2.15.6 Pipe Sleeves

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 6.35 mm space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

2.15.6.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide Schedule 40 or Standard Weight zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 80 mm above finished floor.

2.15.6.2 Sleeves in Partitions and Non-Masonry Structures

Provide zinc-coated steel sheet sleeves having a nominal weight of not less than 4.39 kg per square meter, in partitions and other than masonry and concrete walls, floors, and roofs.

2.16 FINISHES

Provide steel surfaces of equipment including ductless split units, heat pumps, and air conditioners, that do not have a zinc coating conforming to [UNI EN ISO 1461] [UNI EN 10147], or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.17 SOURCE QUALITY CONTROL

2.17.1 Salt-Spray Tests

****
NOTE: The Performance Rating is a combination of the protection rating (Rp) and the appearance rating (Ra) from Tables 1 and 2 in UNI EN ISO 10298.
****

Salt-spray test the factory applied coating or paint system of equipment including ductless split units, heat pumps, and air conditioners in accordance with UNI EN ISO 10289. Conduct test for 500 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures of UNI EN ISO 10289. Performance rating of the

test area shall not be less than 10/2mA, no base metal corrosion and showing moderate staining over not more than 20 percent of the area.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinking type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

3.1.1 Curb Support

Install roof curb on roof structure, level and secure. Install and secure rooftop air conditioners on curbs and coordinate roof penetrations and flashing with roof construction. [Secure units to curb support with anchor bolts.]

3.1.2 Ductless Split Unit Air Conditioners and Heat Pumps

Wall sleeve installation shall provide a positive weathertight and airtight seal.

3.1.3 Unitary Air Conditioning System

Install as indicated, in accordance with requirements of Law 46, including latest updated revisions, and the manufacturer's installation and operational instructions.

3.1.4 Room Air Conditioners

Install units in accordance with manufacturer's instructions. Provide structural mountings, closures, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

3.2 PIPING

Brazing, bending, forming and assembly of refrigerant piping shall conform to ASME/ANSI B31.5.

3.2.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to UNI 5311 and UNI 7145. Installation of hanger types and supports for bare and covered pipes shall conform to UNI 5311 and UNI 7145 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to UNI 5311 and UNI 7145.

3.2.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Install piping adjacent to machine to allow service and maintenance. Braze refrigerant piping with silver solder complying with UNI EN 29453. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with ASME/ANSI B31.5.

3.2.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.

3.2.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size

of driers shall be determined by piping and installation of the unit on location. Install dryers of 820 mL and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed.

3.2.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to 2 or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

3.2.6 Solenoid Valve Installation

Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.2.7 Gas Piping

Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

3.2.8 Hot Water Heating Piping

Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

3.2.9 Steam and Condensate Piping

Comply with applicable requirements in Section [_____], "Steam and Condensate Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening. Traps and piping to drainage disposal points shall conform to Section 15400, "Plumbing Systems."

3.4 DUCT INSTALLATION

Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are

specific connection requirements:

a. Install ducts to termination in roof curb.

b. Connect supply and return ducts to rooftop unit with flexible duct connectors specified in Section 15810, "Ductwork and Ductwork Accessories."

****
NOTE: Coordinate the following 3 paragraphs with roof structure type.
****

c. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

d. For return air plenum applications, terminate return air duct through roof structure.

e. Insulate space between roof and bottom of unit with 2 layers of 50 mm thick, acoustic duct liner.

f. Install normal weight, 20.7 MPa compressive strength (28-day) concrete mix inside roof curb, [100] [___] mm thick. Concrete, formwork, and reinforcement are specified in Section 03300, Cast-In-Place Concrete."

3.5 ACCESS PANELS

Provide access panels for concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

3.6 AIR FILTERS

Allow access space for servicing filters. Coordinate access space with duct, piping, wiring, and general construction to maintain service clearances. Install filters with suitable sealing to prevent bypassing of air.

3.7 FLASHING

****
NOTE: Show details of flashings on drawings.
****

Provide flashing for equipment supports and roof penetrations and flashing where piping or ductwork passes through exterior walls in accordance with Section 07600, "Flashing and Sheet Metal."

3.8 IDENTIFICATION TAGS AND PLATES

Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide

minimum letter and numeral size of 3 mm height.

3.9 FIELD QUALITY CONTROL

3.9.1 Field Tests and Inspections

Perform the following field quality control tests and inspections and prepare test reports:

a. Inspect for and remove shipping bolts, blocks, and tie-down straps.

b. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

d. Remove malfunctioning units, replace with new units, and retest as specified above.

3.9.2 Leak Testing

Upon completion of installation of air conditioning equipment, test factory and field installed refrigerant piping with an electronic type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ASHRAE 15, except that test pressure shall not exceed 1034 kPa (gage) on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.9.3 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field charged and factory charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 133 Pa absolute. Evacuate system in accordance with the triple evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.9.4 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours. Engage a factory authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions and do the following:

a. Inspect for visible damage to unit casing.

b. Inspect for visible damage to compressor, air-cooled outside coil, and fans.

c. Inspect internal insulation.

d. Verify that labels are clearly visible.

e. Verify that clearances have been provided for servicing.

f. Verify that controls are connected and operable.

g. Verify that filters are installed.

h. Clean outside coil and inspect for construction debris.

i. Lubricate bearings on fan.

j. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

k. Start unit according to manufacturer's written instructions.

    1) Start refrigeration system in summer only.

    2) Complete startup sheets and attach copy with Contractor's startup report.

l. Inspect and record performance of interlocks and protective devices; verify sequences.

m. Operate unit for an initial period as recommended or required by manufacturer.

n. Calibrate thermostats.

o. Adjust and inspect high-temperature limits.

p. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.

q. Start refrigeration system and measure and record the following:

    1) Coil leaving air, dry- and wet-bulb temperatures.

    2) Coil entering air, dry- and wet-bulb temperatures.

    3) Outside air, dry-bulb temperature.

    4) Outside air coil, discharge air, dry-bulb temperature.

r. Inspect controls for correct sequencing of [heating,] [mixing dampers,] refrigeration, and normal [and emergency] shutdown.

s. Simulate maximum cooling demand and inspect the following:

1) Compressor refrigerant suction and hot-gas pressures.

2) Short circuiting of air through outside coil or from outside coil to outside-air intake.

t. After startup and performance testing, change filters, vacuum [heat exchanger and] cooling and outside coils, lubricate bearings, [adjust belt tension,] and inspect operation[of power vents].

[u. Adjust fan belts to proper alignment and tension.]

[v. Inspect for visible damage to furnace combustion chamber.]

[w. Clean furnace flue and inspect for construction debris.]

[x. Connect and purge gas line.]

[y. Adjust vibration isolators.]

[z. Inspect operation of barometric dampers.]

[aa. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.

1) Measure gas pressure on manifold.

2) Measure combustion air temperature at inlet to combustion chamber.

3) Measure flue gas temperature at furnace discharge.

4) Perform flue gas analysis. Measure and record flue gas carbon dioxide and oxygen concentration.

5) Measure supply air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.]

****
NOTE: Delete the following paragraph if test and balance work is specified in another Division 15 section. For variable-air-volume systems the designer should delete the following and utilize Section 15950, "HVAC Testing/Adjusting/Balancing."
****

[ab. Measure and record the following airflows. Plot fan volumes on fan curve.

1) Supply air volume.

2) Return air volume.

3) Outside air intake volume.

[4) Relief air volume.]

][ac. Verify operation of remote panel, including pilot light operation and failure modes. Inspect the following:

1) High limit heat exchanger.

2) Warm up for morning cycle.

3) Freezestat operation.

4) Economizer to limited outside air changeover.

5) Alarms.

]

3.9.5 Equipment

3.9.5.1 Field Acceptance Test Plans

a. Manufacturer's Test Plans: Within [120] [_____] calendar days after contract award, submit the following plans:

[(1) Room air conditioners - field acceptance test plan]

[(2) Split system heat pump - field acceptance test plan]

[(3) Packaged heat pump - field acceptance test plan]

[(4) Split system air conditioning unit - field acceptance test plan]

[(5) Packaged air conditioning unit - field acceptance test plan]

[(6) Packaged air handling unit - field acceptance test plan]

Field acceptance test plans shall be developed by the equipment manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing subcontractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

The Contracting Officer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance test plans shall be the plan and procedures followed for the field acceptance tests of the equipment and test reporting.

b. Coordinated testing: Indicate in each field acceptance test plan

when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of equipment controls which interlock and interface with controls factory prewired or external controls for the equipment provided under [Section 15901, "Space Temperature Control Systems"] [Section 15910, "Direct Digital Control Systems"].

c. Prerequisite testing:

(1) Start-up and Initial Operational Tests as specifed elsewhere in this section shall be completed prior to commencing with Field Acceptance Testing.

[(2) Equipment for which performance testing is dependent upon the completion of the work covered by Section 15950, "HVAC Testing/Adjusting/Balancing" must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.]

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures shall be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

e. Performance variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Manufacturer shall furnish with each test procedure a description of acceptable results that have been verified.

Manufacturer shall identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

f. Job Specific: Each test plan shall be job specific and shall address the particular item of equipment and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized Components: Each test plan shall include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.9.5.2 Field Acceptance Testing

a. Equipment Requiring Test Reports: Each piece of equipment listed shall be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

[(1) Room air conditioners - field acceptance test report]

[(2) Split system heat pump - field acceptance test report]

[(3) Packaged heat pump - field acceptance test report]

[(4) Split system air conditioning unit - field acceptance test report]

[(5) Packaged air conditioning unit - field acceptance test report]

[(6) Packaged air handling unit - field acceptance test report]

b. Manufacturer's Recommended Testing: Conduct the manufacturer's recommended field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.

c. Operational Test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every 2 hours. Use the test report forms for logging the operational variables.

d. Notice of Tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report Forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC manager. The manufacturer's field test representative shall review, approve, and sign the report of all manufacturer's recommended tests. Signatures shall be accompanied by the person's name typed.

f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.9.5.3 Field Acceptance Testing of Minor HVAC Equipment

[For equipment not covered by test plans and test reports specified above, test][Test] each item of equipment in operation for continuous period of not less than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that the equipment operating parameters are within limits recommended by the manufacturer.

[3.9.6 Manufacturer's Field Service

****
NOTE: Manufacturer's field service should be included for systems 70kW and larger.
****

Engage a factory authorized service representative to inspect field assembled components and equipment installation, including connections. Report results in writing.

]3.10 ADJUSTING

3.10.1 Project Adjustments

Adjust initial temperature and humidity set points. Set field adjustable switches and circuit breaker trip ranges as indicated.

3.10.2 Occupancy Adjustments

When requested within 12 months of date of acceptance by the Contracting Officer, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

-- End of Section --